MGM University,

Chh. Sambhajinagar

A

Ph.D. Final Synopsis on

"Predictive Analysis of Placement of MCA Students Using Machine Learning Algorithms With Reference to Marathwada Region"

In

Management & Commerce

By

Vinod S.Agrawal

Under the Guidance of
Dr.Sarika Kadam Shelke

October -2024

Final Synopsis

1. **Introduction (Research Problem, Objectives, Significance)**
2. **Literature Review (Key Theories, Research Gap)**
3. **Research Methodology (Design, Sampling, Data Collection, Analytical Tools)**
4. **Data Analysis & Key Findings (Visual Aids like Charts, Tables)**
5. **Discussion (Interpretation, Implications)**
6. **Contributions (Theoretical, Practical)**
7. **Conclusion (Key Findings, Recommendations)**
8. **Limitations & Future Scope (Acknowledgement of Limitations, Future Research)**
9. **Bibliography (As per APA style)**

Name & Signature

(ResearchScholar)

Name & Signature

(ResearchGuide)

1.Introduction

Research Problem:

Predictive Analysis of Placement of MCA Students using Machine Learning Algorithms with reference to Marathwada Region

Objectives:

- To develop a predictive placement model.
- To assess the effectiveness and performance of various machine learning algorithms.
- To identify and analyze academic performance influencing the job placement of MCA students.
- To assess the impact of demographic factors on job placement of MCA students.

Significance:

- **Addressing Regional Challenge:**

  The Marathwada region faces employment challenges. This research specifically targets academic performance, demographic factors influencing MCA student placements.
- **Data-Driven Decision Making:**

  By employing machine learning algorithms, the study provides a systematic approach to understand placement dynamics, enabling students and educational institutes to make informed decisions.
- **Enhancing Placement Strategies:**

  The findings will help students and educational institutes to develop effective placement strategies, focusing on critical success factors such as academic performance and skills development.
- **Empowering Students**:

  The predictive model equips students with knowledge about their placement prospects, helping them to identify areas for improvement and guiding their career development efforts.
- **Contribution to Academia**:

  This research contributes to the growing field of educational data mining, demonstrating the practical application of machine learning in predicting outcomes and improving educational practices.
- **Improving Graduate Employability**:

  By highlighting the key predictors of successful placements, the study aims to enhance the overall employability of MCA graduates

2. Literature Review:

Key Theories:

Identification of relevant work	
Search attributes	**Details**
Database	Scopus, IEEE Xplore, Google Scholar
Major keywords	predictive analysis, placement prediction, student placement, machine learning, classification algorithms, campus placement prediction
Search scope	Title, Abstract, Keyword
Publication year	2014 onwards
Document Type	Journal Article, Conference papers, Thesis

Assessment of quality of studies	
Criteria	**Inclusion**
Relevance	Work related to campus placement prediction, comparative study of various machine learning models
Methodology	Studies employing machine learning techniques such as classification, regression, or clustering algorithms were included

Research Gap:

- Research study for Marathwada region MCA students
- Qualitative analysis
- Extracurricular activities feature/parameter/variable not considered in most of the previous research
- Hypothesis testing missing in the past research to know the impact of demographic factors and academic performance on job placement

3. Research Methodology:

Research Design: Hybrid (Quantitative & Qualitative)

- **Quantitative-** Predictive analysis of campus placement
- **Qualitative-** Thematic analysis for recommendations

Sampling:

Sampling method: Random Sampling

Sample size: 291 MCA alumni participated from marathwada region.

Data Collection: Structured Questionnaire

Analytical tools: Jupyter notebook, Google Colab , SPSS

4. Data Analysis (Quantitative):

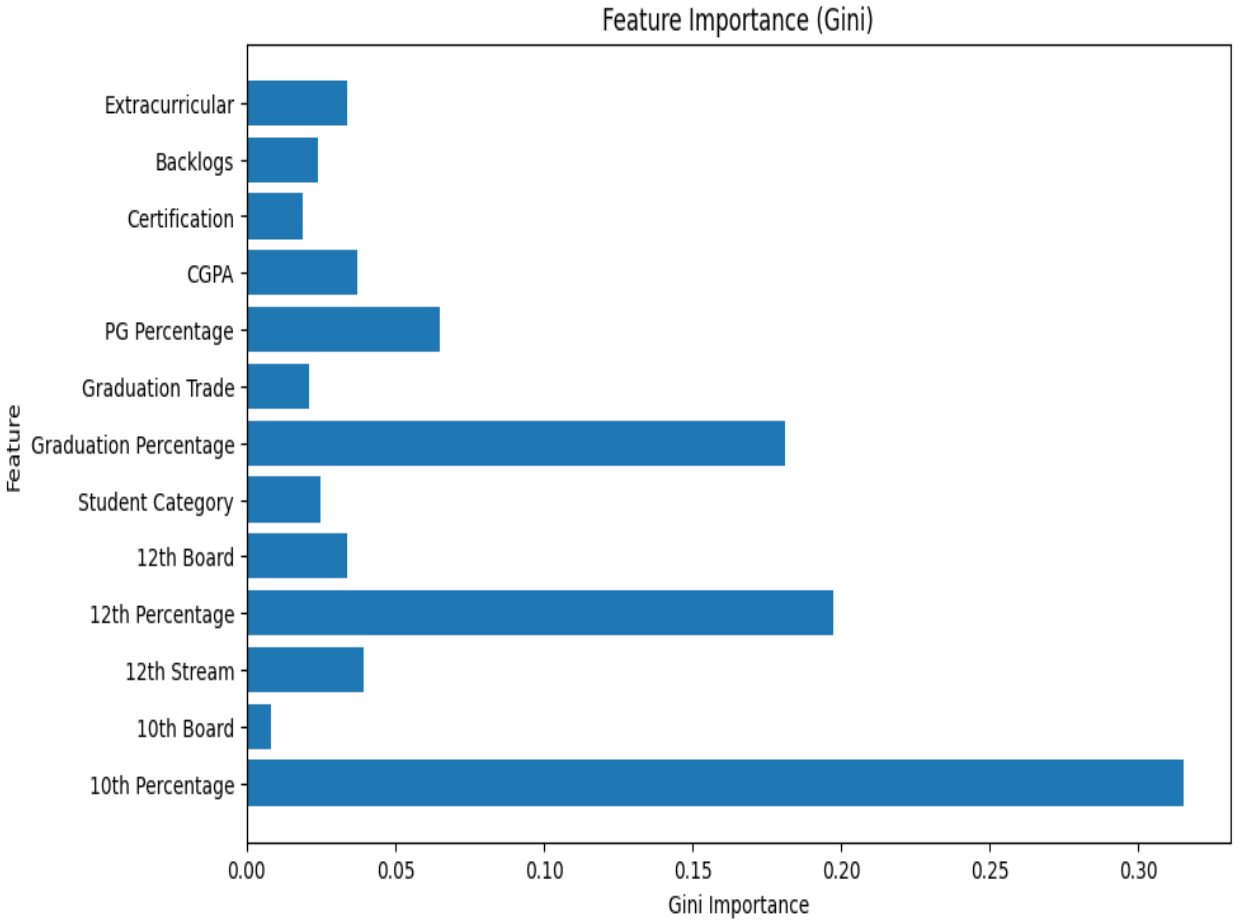
Performance analysis of ML models:

ML Model	True Positive	False Positive	True Negative	False Negative	Accuracy (K-Fold Cross Validation)
Decision Tree	9	0	50	0	100%
Random Forest	9	0	50	0	100%
Logistic Regression	9	0	50	0	100%
Naïve Byes	9	14	36	0	76%
KNN	0	3	47	9	80%
SVM	0	0	50	9	85%
XGBoost	9	0	50	0	100%
AdaBoost	9	0	50	0	100%

Comparision of learning models build execution time (in seconds):

ML Model	Accuracy (K-Fold Cross Validation)	Build Execution time (in seconds)
Decision Tree	100%	0.007998
Random Forest	100%	0.220382
Logistic Regression	100%	0.044023
XGBoost	100%	0.186318
AdaBoost	100%	0.017056

Feature importance table using Gini method:



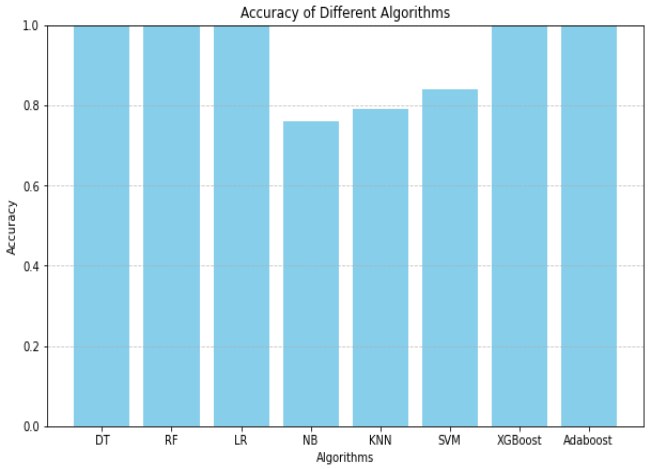
Hypothesis Testing:

- **H1: Job placement of MCA students is predictable based on the previous academic details of the students.**

  Null hypothesis: There is no significant difference between actual model and predicted model

  Alternate hypothesis: There is significant difference between actual model and predicted model

```
Decision Tree Accuracy: 1.0
Random Forest Accuracy: 1.0
Logistic Regression Accuracy: 1.0
Naive Bayes Accuracy: 0.7627118644067796
KNN Accuracy: 0.7966101694915254
SVM Accuracy: 0.847457627118644
XGBoost Accuracy: 1.0
AdaBoost Accuracy: 1.0
```



- **Interpretation:**

  From above results it is clear that when we assess test dataset on trained dataset it is found that accuracy of right classification is about 100% in Decision Tree(DT), Random forest(RF), logistic regression(LR), AdaBoost and XGBoost which means actual model and predicted model are not different which proves hypothesis that Job placement of MCA students is predictable on previous academic details.

- **H2: Decision tree is best suitable algorithm for job placement prediction**

  Null Hypothesis: There is no significant difference in the accuracy of predicting the placement of a student using Decision Tree compared to other algorithms.

  Alternate Hypothesis: There is significant difference in the accuracy of predicting the placement of a student using Decision Tree compared to other algorithms.

ML Model	Accuracy (K-Fold Cross Validation)	Build Execution time (in seconds)
Decision Tree	100%	0.007998
Random Forest	100%	0.220382
Logistic Regression	100%	0.044023
XGBoost	100%	0.186318
AdaBoost	100%	0.017056

- **Interpretation:**

  we observe the build execution time of these algorithms it is observed that DT (Decision Tree) algorithm takes least time to execute/train the model. Hence Decision tree is best suitable algorithm for job placement prediction.

- **H3: Higher academic performance in prior education (SSC, HSC, UG) is more likely that a student is being placed**

  Null Hypothesis: Higher academic performance in prior education (SSC, HSC, UG) does not increase the likelihood of a student being placed

  Alternate Hypothesis: Higher academic performance in prior education (SSC, HSC, UG) increases the likelihood of a student being placed

  Accuracy: 0.847457627118644

  Coefficient Values:

  10th Percentage : 0.015337705281505087

  12th Percentage : 0.04539089551566619

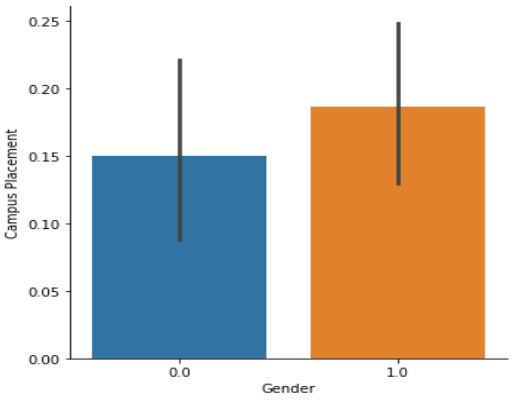
  Graduation Percentage : 0.027986195612339698

- **Interpretation:**

  The positive coefficients show that the higher academic performance in SSC, HSC, and UG is related with a higher success of being placed. Therefore, we reject the null hypothesis.

  It is also observed from feature importance graph that 10th percentage, 12th percentage and graduation percentage are more significant towards placement outcomes. Hence alternate hypothesis accepted.

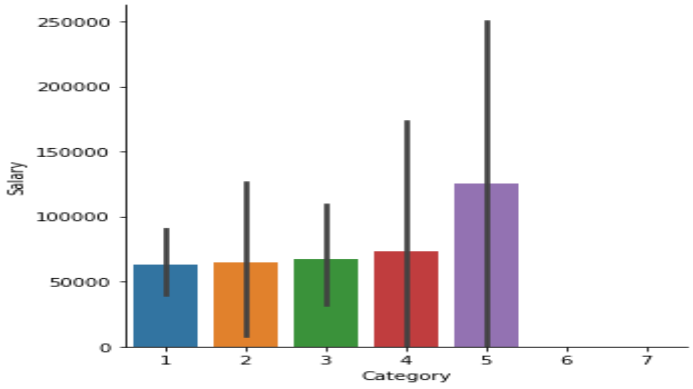
- **H4. Gender does not impact job placement**.
  Null hypothesis: Gender does not have an impact on job placement. This means that the probability of job placement is the same for all genders.
  Alternative hypothesis: Gender has an impact on job placement. This means that the probability of job placement is different for at least one gender.



Chi-squared statistic: 0.2697
Degrees of freedom: 1
p-value: 0.6035

- **Interpretation:**
- The p-value indicates the probability of observing the calculated chi-squared statistic under the null hypothesis. In this case, the p-value of 0.6035 is greater than significance level, indicating that no significant evidence to reject the null hypothesis. This proves that Gender does not impact job placement.

- **H5. Student caste category does not impact job placement**
  Null Hypothesis: Student caste category does not impact job placement
  Alternate Hypothesis: Student caste category impacts job placement



F-statistic: 0.4975
p-value: 0.8101

- **Interpretation:**
- Since the p-value (0.8101) is greater than 0.05, there is insufficient evidence to reject null hypothesis. Therefore, we fail to reject the null hypothesis, means there is no significant impact on job placement by student caste category.

Data Analysis (Qualitative):

- **A) Qualitative analysis performed on the responses received from the MCA alumni. Alumni who didn't got the job were asked to write about how they landed their first job.**

Frequency distribution table (91 responses)

Sr.No	Theme	Percentage
1	Persistence and Determination	55
2	Skill Improvement and Up skilling	37.77
3	Networking and Referrals	26.66
4	Tailoring Applications and Personalization	55
5	Adaptability and Flexibility	24.44
6	Utilization of Online Portals	45.55
7	Challenges of the Job Market	25.55
8	Location and Relocation	15.55
9	Initial Rejections and Success Over Time	52.22

- **Persistence and Determination (55%)**: Many individuals expressed facing challenges and rejections during their job search, but they persisted and continued to apply through various channels such as online portals, job fairs, company websites, and even personal visits to companies.
- **Skill Improvement and Up skilling (37.77%)**: Several individuals mentioned actively working on improving their skills and gaining more experience through internships, courses, certifications, and freelancing projects. They recognized the importance of aligning their skills with the requirements of the job market.
- **Networking and Referrals (26.66)**: Networking played a significant role for some individuals, either through industry events, LinkedIn connections, or referrals from friends and colleagues. Referrals often led to job opportunities or at least facilitated the interview process.
- **Tailoring Applications and Personalization (55%)**: Successful candidates tailored their resumes and cover letters to match the specific requirements of the companies they applied to. They also personalized their approach, highlighting their relevant experiences and skills.
- **Adaptability and Flexibility (24.44 %)**: Some individuals mentioned being open to various job opportunities, whether it was a tech support role, software development, teaching, or even switching industries. Flexibility and adaptability seemed to be key in navigating the job market.

- **Utilization of Online Portals (45.55%)**: Naukri.com and LinkedIn were popular platforms for job seekers, indicating the importance of utilizing online job portals for job search activities.
- **Challenges of the Job Market (25.55%)**: Many individuals mentioned facing challenges such as recession, high competition, and a limited number of job opportunities, which made the job search process frustrating and difficult.
- **Location and Relocation (15.55%):** Some candidates mentioned the importance of considering location preferences and being willing to relocate for job opportunities, while others faced challenges due to location constraints.
- **Initial Rejections and Success Over Time (52.22%)**: Despite facing initial rejections and difficulties, many individuals eventually found success in landing a job through continuous improvement, and learning from previous experiences.

- **B) Qualitative analysis performed on the responses received from the MCA alumni regarding participation in extracurricular activities.**

Frequency distribution table (92 responses)

Sr.No	Theme	Percentage
1	Academic Achievements	19.23
2	Extracurricular Activities	63.04
3	Leadership and Organizational Roles	27.17
4	Skill Development	22.83
5	Networking and Recruitment	13.04
6	Recognition and Awards	7.61
7	Community Engagement	20.65
8	Personal Interest	5.43
9	Professional Development	3.26
10	Teamwork and Collaboration	25

- **Academic Achievements (19.23%)**

  Academic success remains a foundational element of personal development and is often seen as a stepping stone to future opportunities. Example: Winning competitions, participating in technical events, workshops, and seminars.

- **Extracurricular Activities (63.04%)**

  This high percentage indicates that individuals engaged in diverse activities such as sports, arts, and volunteer work, which foster critical skills such as teamwork, resilience, and creativity. Examples: Participating in college events, cultural activities, sports teams, drama, fashion shows, and organizing committees

- **Leadership and Organizational Roles (27.17%)**

  Leadership and organizational roles are pivotal for personal and professional growth. These experiences are crucial for preparing individuals for future leadership positions in various fields. Examples: Serving as student coordinator, council member, president of student associations, and being involved in event management and organization.

- **Skill Development (22.83%)**

  Skill development is a vital theme that reflects individuals' commitment to continuous learning. This percentage indicates a proactive approach to acquiring both hard and soft skills. Examples: Participating in coding contests, mock interviews, personality development courses, and technical workshops.

- **Networking and Recruitment (13.04%)**

  Networking and recruitment highlight the strategic importance of building professional relationships. Participants may seek opportunities to connect with industry professionals through internships or networking events, which can lead to career advancements. Examples: Involvement through faculty recommendation, recruitment drives, involvement in department-level activities, and being a part of sports clubs.

Recognition and Awards (7.61%)

Recognition and awards, while valuable, represent a smaller aspect of personal and professional development. Examples: Winning prizes, being awarded as the best singer, receiving certifications, and achieving runner-up positions.

Community Engagement (20.65%)

Community engagement is a key theme that showcases a commitment to social responsibility. The percentage suggests that many individuals participated in community service or local initiatives, reflecting a desire to give back and make a positive impact. Examples: Participating in social gatherings, volunteering programs, and community events.

Personal Interest (5.43%)

Personal interest reflects individual passions and hobbies, which contribute to well-roundedness. The low percentage suggests that while personal interests are acknowledged, they may take a backseat to more structured activities and responsibilities. Nonetheless, pursuing personal interests is crucial for mental well-being and self-expression. **Professional Development (3.26%)**

This could reflect a focus on gaining practical experience through internships and extracurricular activities rather than formal professional development initiatives.. Examples: Completing internships, publishing research, participating in interview preparation, and involvement in industry-level events.

Teamwork and Collaboration (25%)

The significance of teamwork and collaboration is highlighted by this notable percentage. Engaging in collaborative efforts are required to enhance interpersonal skills. Examples: Being part of cricket teams, robo race competitions, quiz competitions, and collaborating in department-wise activities.

C)Qualitative analysis performed on the responses received from the MCA alumni regarding use of social networking.

Sr.No	Theme	Percentage
1	Profile Creation and Optimization	69.2
2	Skill Highlighting,Projects and Certification	22.69
3	Networking and Social Media	29.56
4	Continuous Learning and Development	10.33
5	Utilization of Multiple Platforms	40.98
6	Professionalism and Presentation	20.22
7	Adaptation to Market Trends	8.19
8	Persistence and Consistency	3.28

Profile Creation and Optimization (69.2%): MCA graduates should focus on creating and optimizing their profiles on professional platforms like LinkedIn, Naukri, Indeed, and others. This includes ensuring their profiles are complete, up-to-date, and include a professional photo.

Skill Highlighting and Certification(22.69%): Emphasis is placed on highlighting relevant skills, certifications, and work experience. This helps in attracting potential employers and increasing visibility in the job market.

Networking and Engagement (29.56%): Networking is considered essential for job placement. MCA graduates are advised to actively engage with industry professionals, join relevant groups, participate in discussions, and attend networking events.

Continuous Learning and Development(10.33%): There's a focus on continuous learning and skill development, including completing certifications, staying updated with industry trends, and improving technical skills.

Utilization of Multiple Platforms (40.98%): Apart from LinkedIn and Naukri, graduates are encouraged to utilize other job portals and social media platforms like Facebook, Twitter, and Instagram to expand their job search and network.

Professionalism and Presentation (20.22%): The importance of professionalism in online presence, including maintaining a positive attitude, authentic interactions, and using a professional tone, is highlighted.

Adaptation to Market Trends (8.19%): Graduates are advised to adapt to market trends, identify their areas of interest, and tailor their profiles and skills accordingly to increase their employability.

Persistence and Consistency (3.28%): Persistence, consistency, and patience are emphasized in the job search process. Graduates are encouraged to keep their profiles updated, actively search for job opportunities, and engage in continuous self-improvement.

5. Discussion:

Interpretations:

- Job placement of MCA students is predictable based on the previous academic details of the students.
- Decision tree is best suitable algorithm for job placement prediction
- Higher academic performance in prior education (SSC, HSC, UG) is more likely that a student is being placed
- Gender does not impact job placement.
- Student caste category does not impact job placement

Implications:

The insights gained from the thematic analysis of job-seeking behaviors and experiences carry significant implications for various stakeholders, including educators, employers, and job seekers

1. For Educators and Institutions

Curriculum Enhancement: Educational institutions should consider integrating skill development and practical experience into their curricula. By emphasizing experiential learning through internships, projects, and extracurricular activities, institutions can better prepare students for the realities of the job market.

Workshops and Career Services: Offering workshops focused on resume tailoring, interview preparation, and networking strategies can equip students with essential tools for their job search. Career services should also provide personalized guidance to help students navigate the complexities of job applications and networking.

Promoting Soft Skills: Emphasizing the development of soft skills like adaptability, teamwork, and persistence is crucial. Institutions can foster these skills through group projects, leadership opportunities, and community engagement activities.

2. For Employers

Recognizing Diverse Experiences: Employers should broaden their criteria for evaluating candidates to include experiences gained through extracurricular activities, internships, and community engagement. This recognition can help identify candidates who possess practical skills and a proactive mindset.

Networking Opportunities: Companies can enhance their recruitment strategies by creating networking events or participating in career fairs. This approach not only allows candidates to connect with industry professionals but also facilitates a smoother hiring process through referrals.

Training and Development Programs: Employers should consider implementing ongoing training and development programs to support the continuous improvement of their employees' skills. This can help bridge the gap between academic learning and workplace expectations.

3. For Job Seekers

Proactive Skill Development: Job seekers should prioritize continuous learning and upskilling. Engaging in relevant courses, certifications, and practical experiences will align their skills with market demands and improve their employability.

Effective Networking: Understanding the importance of networking can empower job seekers to actively engage with industry professionals and peers. Building a strong professional network can open doors to job opportunities and valuable insights about the industry.

Personalization in Applications: Candidates should invest time in tailoring their resumes

and cover letters to highlight specific skills and experiences relevant to each job application. Personalization can significantly increase their chances of standing out in a competitive job market.

Persistence and Resilience: Recognizing that initial rejections are a normal part of the job search process can help job seekers maintain persistence and resilience. Learning from setbacks and continuously improving their approaches can ultimately lead to success.

4. For Professional Platforms and Job Portals

User Experience Improvements: Job portals should focus on enhancing user experiences by providing resources and tools that guide users in optimizing their profiles, utilizing networking features, and accessing skill development opportunities.

Educational Content: Offering educational content, such as articles and webinars on effective job search strategies and industry trends, can further empower job seekers to navigate their career paths more effectively.

6. Contributions:

Theoretical:

Enhanced Understanding: This research contributes to the existing body of knowledge by integrating qualitative insights with quantitative analysis.

Hypothesis Testing: By testing five specific hypotheses, this study expands the theoretical framework of student placements and provides evidence for future research.

New Themes Identified: The thematic analysis revealed critical themes like Persistence and Determination, Tailoring Applications and Personalization, Extracurricular Activities, Profile Creation and Optimization that enrich theoretical discussions around employability and education.

Practical:

- **Career Development Programs**: Educational institutions can develop targeted career guidance and skill development programs based on the identified factors, enhancing students' employability.
- **Strategic Partnerships**: The research encourages collaboration between educational institutions and industry to create training opportunities that align with market needs, benefiting both students and employers.

7. Conclusion:

Key findings:

Emphasis on Persistence and Adaptability: A significant portion of job seekers demonstrated persistence in the face of challenges and rejections. This determination, coupled with a flexible approach to job opportunities, proved crucial for eventual success.

Importance of Skill Improvement and Up skilling: Continuous skill development emerged as a critical factor, with many individuals actively seeking internships, certifications, and other experiences to align their skills with job market demands. This proactive approach to learning is vital for enhancing employability.

Networking as a Strategic Tool: Networking played a prominent role in job placement. Building professional connections through industry events and referrals not only facilitated access to job opportunities but also enriched candidates' understanding of the industry landscape.

Tailoring Applications for Success: Successful candidates often personalized their applications to match specific job requirements, indicating that customization in resumes and cover letters is a key strategy for standing out in a competitive job market.

Utilization of Digital Platforms: Online job portals, such as LinkedIn and Naukri, were widely used, highlighting the importance of an effective online presence. Candidates who optimized their profiles and utilized multiple platforms had greater visibility and access to job opportunities.

Recognition of Holistic Development: Engagement in extracurricular activities and community service was shown to contribute significantly to personal growth and the development of soft skills. These experiences are increasingly valued alongside academic achievements.

Navigating Market Challenges: Job seekers expressed awareness of external challenges such as high competition and economic fluctuations, which added complexity to the job search process. Understanding these market dynamics is essential for developing effective strategies.

Role of Academic Achievements: While academic success remains important, there is a noticeable shift towards valuing practical experiences and skills over traditional academic metrics. This reflects a broader understanding of what constitutes readiness for the workforce.

Recommendations:

For Educational Institutions:

- Develop and implement skill enhancement programs focused on communication, teamwork, and networking, based on the themes identified in the analysis.
- Foster mentorship programs that connect students with alumni and industry professionals to provide guidance and networking opportunities.

For Students:

- Actively participate in extracurricular activities and internships to build practical skills and professional networks that enhance employability.
- Seek feedback and guidance from mentors to identify areas for improvement and align personal goals with industry expectations.

For Industry:

- Collaborate with educational institutions to create training and job opportunities that reflect current industry needs and practices.
- Engage in regular dialogues with academic institutions to inform curriculum development, ensuring that graduates are equipped with relevant skills and knowledge.

8. Limitations & Future Scope:

Limitations:

- **Sample Size** : sample size can be improved
- **Features Considered** : More number of features can be identified to get more insights
- **Algorithm Selection**: Different algorithms except considered in this research study might produce varying outcomes.
- **Scope of Recommendations**: In this study recommendations provided based on the MCA alumni experiences. The implementation of the personalized recommendations might require

additional resources, time, and feasibility considerations that were not fully explored in the research

Future Scope/ Research:

- **Placement percentage :**

  Future research can calculate the placement percentage of a particular class having N number of students.

- **Longitudinal Study:**

  Conduct longitudinal research to track the placement outcomes of MCA students over time

- **Broader Sample Diversity:**

  Broader Sample Diversity to include more no of samples that can potentially generalizing findings to a wider population.

- **Integration of Qualitative Methods:**

  Future research can further integrate qualitative methods, such as interviews to gain deeper insights into student experiences and perceptions regarding their placement journeys.

- **Impact of Industry Trends:**

  Investigate the impact of emerging industry trends, such as technology advancements and remote work, on the employability of MCA graduates and the skills that are increasingly in demand.

9.Bibliography:

Research Papers/ Thesis:

1.Jose I. T., Raju D., Aniyankunju J. A., James J. & Vadakke M. T. (2020). Placement prediction using various machine learning models and their efficiency comparison. International Journal of Innovative Science and Research Technology. Vol-5:5; pp.1005-1009

2.Jeevalatha T., Ananthi N. & Kumar D. S. (2014). Performance analysis of undergraduate students placement selection using decision tree algorithms. International Journal of Computer Applications. Vol-108:15; pp.27-31.

3.Casuat C. D. & Festijo E. D. (2019). Predicting students' employability using machine learning approach. In 2019 6th IEEE International Conference on Engineering Technologies and Applied Sciences (ICETAS). https://doi.org/10.1109/ICETAS48360.2019.9117338

4.Giri A. Bhagavath M. V. V. Pruthvi, B. & Dubey N. (2016). A placement prediction system using k-nearest neighbors classifier. In 2016 Second International Conference on Cognitive Computing and Information Processing (CCIP). https://doi.org/10.1109/CCIP.2016.7802883

5.Ingale Y., Bedse T., Khairnar S. & Ghute D. (2020). Student's Placement Prediction Using Support Vector Machine. International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT). Vol-6:5; pp.55-60. https://doi.org/10.32628/CSEIT206511

6.Shukla M. K., Rambade P., Torasakar J., Prabhu, R. & Maste D. (2017). Students placement prediction model using logistic regression. International Journal of Engineering Research & Technology (IJERT), ICIATE 2017 Conference Proceedings. https://www.ijert.org/students-placement-prediction-model-using-logistic-regression

7.Manvitha P., & Swaroopa N. (2019). Campus placement prediction using supervised machine learning techniques. International Journal of Applied Engineering Research, Vol-14:9; pp.2188-2191.

8.Samatha J., Manjusha D., Pooja B. & Usha A. (2020). Student placement chance prediction. Journal of Emerging Technologies and Innovative Research (JETIR), Vol-7:5

9.Rajeshkumar S., Seenivasagam V., Vijayakumar D. & Saravanaselvi, S. (2020). A survey on investigation of students placement log using machine learning algorithms. International Journal of Scientific & Technology Research. 9:2, pp.1925-1929. Retrieved from http://www.ijstr.org

10.Anvesh K., Prasad B. S., Laxman V. V. S. R. & Narayana B. S. (2019). Automatic Student Analysis and Placement Prediction using Advanced Machine Learning Algorithms. International Journal of Innovative Technology and Exploring Engineering (IJITEE). Vol-8:12; pp.4178. DOI: 10.35940/ijitee.L3664.1081219
11.Harihar V. K., Bhalke D. G. & SAMRIDDHI. (2020). Student Placement Prediction System using Machine Learning. SAMRIDDHI, Vol-12:2, Print ISSN: 2229-7111, Online ISSN: 2454–5767.
12.Muthusenthil B., Mugesh V., D. Thansh & Subaash R. (2020). Predictive Analysis Tool for Predicting Student Performance and Placement Performance using ML algorithms. International Journal of Advance Research and Innovative Ideas in Education (IJARIIE), VOl-6:2, ISSN(O): 2395-4396, 11525.pp. 228.
13.GAUTAMI G., HAYAT M., BANERJEE P. & KUMAR B. (2020). Prediction of Student Placement Using Machine Learning Algorithm. International Journal of Current Research and Technology (IJCRT), VOl-8:5
14.Sharma A. S., Prince S., Kapoor S. & Kumar K. (2014). PPS - Placement Prediction System using Logistic Regression. In 2014 IEEE International Conference on MOOC, Innovation and Technology in Education (MITE) pp. 337-341.
15.Harinath S., Prasad A., Suma H. S., Suraksha A. & Mathew T. (2019). Student Placement Prediction Using Machine Learning. *International Research Journal of Engineering and Technology (IRJET)*, Vol-6:4; 4577.
16.Rao K. S., Swapna N. & Kumar P. P. (2018). Educational data mining for student placement prediction using machine learning algorithms. *International Journal of Engineering & Technology, Vol-7*(1.2); pp.43-46.
17.Cai C. Y., Lu H., Yan K. & Ye M. (2018). Intelligent placement model based on decision tree. In *2018 9th International Conference on Information Technology in Medicine and Education* ; pp.2474-3828. DOI: 10.1109/ITME.2018.00188.
18.Aravind T., Reddy B. S., Avinash S. & Jeyakumar G. (2019). A Comparative Study on Machine Learning Algorithms for Predicting the Placement Information of Undergraduate Students. In *Proceedings of the Third International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2019)*. IEEE Xplore Part Number: CFP19OSV-ART; ISBN: 978-1-7281-4365-1.
19.Kumbhar C. & Sridhar S. S. (2018). Trend analysis of university placement by using machine learning algorithms. *International Journal of Engineering & Technology, Vol-7*(2.4); pp.178-181.
20.Shetty B. A., Pasha A., Singh S. A., Shreyas N. I. & Hande A. R. (2019). Comparative Study of Multiple Machine Learning Algorithms for Students' Performance Data for Job Placement in University. *International Journal of Engineering and Advanced Technology (IJEAT)*, Vol-8(5S), May.
21.Bangale, M., Bavane S., Gunjal A., Dandhare R. & Salunkhe S. D. (2019). A Survey on Placement Prediction System Using Machine Learning. *International Journal of Science and Advance Research in Technology (IJSART)*, Vol-5(2).
22.Suresh Kumar R., Dilsha F., Shilp, A. N.& Sumayya A. A. (2021). Student Placement Prediction Using Support Vector Machine Algorithm. *International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering (IJIREEICE)*, Vol-9(5). DOI: 10.17148/IJIREEICE.2021.9507.
23.Navyashree S. L., Gnanavi N., Deeksha D., Krupa N. & Malhotra M. (2019). Evaluating Supervised Machine Algorithms for Student Placement Prediction. *International Research Journal of Engineering and Technology (IRJET)*, Vol-6(2), 1367.
24.Sharma S., Pandey S. K. & Garg K. (2020). Machine Learning for Predictions in Academics. *International Journal of Recent Technology and Engineering (IJRTE)*, Vol-8(5); pp. 4624-4627. ISSN: 2277-3878.
25.Thangavel S. K., Bharathi D. P. & Sankar A. (2017). Student Placement Analyzer: A Recommendation System Using Machine Learning. In *2017 International Conference on Advanced Computing and Communication Systems (ICACCS -2017)* ,Coimbatore, India.
26.Bhatt H., Mehta S. & D'mello L. R. (2015). Use of ID3 Decision Tree Algorithm for Placement

Prediction. *International Journal of Computer Science and Information Technologies (IJCSIT)*, Vol-6(5); pp.4785-4789.
27.Kumar D. S., Bin Siri Z., Rao D. S. & Anusha S. (2019). Predicting Student's Campus Placement Probability using Binary Logistic Regression. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, Vol-8(9); pp. 2633-2635. ISSN: 2278-3075.
28.Kadambande A., Thakur S., Moho, A. & Ingole A. M. (2017). Predicting Student's Performance System. *International Research Journal of Engineering and Technology (IRJET)*, Vol-4:5, 2814.
29.Oloruntoba S. A., & Akinode J. L. (2017). Student Academic Performance Prediction Using Support Vector Machine. *International Journal of Engineering Sciences & Research Technology (IJESRT)*, VOl-6:12, pp.588-598.
30.Somvanshi M., Tambade S., Chavan P. & Shinde, S. V. (2016). A Review of Machine Learning Techniques using Decision Tree and Support Vector Machine. In *2016 International Conference on Computing Communication Control and Automation (ICCUBEA)*. DOI: 10.1109/ICCUBEA.2016.7860040.
31.Khandale S., & Bhoite S. (2019). Campus Placement Analyzer: Using Supervised Machine Learning Algorithms. *International Journal of Computer Applications Technology and Research*, VOl-8:09; pp.358-362. ISSN: 2319–8656.
32.Maurya L. S., Hussain M. S. & Singh S. (2021). Developing Classifiers through Machine Learning Algorithms for Student Placement Prediction Based on Academic Performance. *Applied Artificial Intelligence*, Vol-35:6; pp.403-420. DOI: 10.1080/08839514.2021.1901032.
33.Saheed Y. K., Oladele T. O., Akanni A. O. & Ibrahim, W. M. (2018). Student Performance Prediction Based on Data Mining Classification Techniques. *Nigerian Journal of Technology (NIJOTECH)*, VOl-37:4; pp.1087-1091. DOI: http://dx.doi.org/10.4314/njt.v37i4.31.
34.Viram R., Sinha S., Tayde B. & Shinde A. (2020). Placement Prediction System Using Machine Learning. *International Journal of Creative Research Thoughts (IJCRT)*, Vol-8:4; pp.1507-1515.
35.Anuradha C. & Velmurugan, T. (2016). Feature Selection Techniques to Analyse Student Academic Performance Using Naïve Bayes Classifier. In *The 3rd International Conference on Small & Medium Business 2016* ; pp.345. January 19-21, 2016, Vietnam.
36.Acharya A. & Sinha, D. (2014). Early Prediction of Students Performance using Machine Learning Techniques. *International Journal of Computer Applications*, Vol-107:1; pp.37-43.
37.Tarekegn G. B. & Sreenivasarao V. (2016). Application of Data Mining Techniques to Predict Students Placement into Departments. *International Journal of Research Studies in Computer Science and Engineering (IJRSCSE)*, Vol-3:2; pp.10-14. 38.Ahmed S., Zade A., Gore S., Gaikwad P.& Kolhal M. (2018). Performance Based Placement Prediction System. *International Journal of Advance Research and Innovative Ideas in Education (IJARIIE)*, Vol-4:3; pp.1544-1551.
39.Mehta S. H. & Adholiya A. (2019). Predicting Students' Performance using J48 Decision Tree. In *National Conference on "Recent Trends in Mathematical Modeling, Simulation Methods, Computations, and Physical Sciences" (MMSCP-2019)*, Organized by Hislop College, Nagpur, Maharashtra, India. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT)*, Vol-4:4; pp. 132-136. ISSN: 2456-3307.
40.Varade R. V. & Thankanchan, B. (2021). Academic Performance Prediction of Undergraduate Students using Decision Tree Algorithm. *SAMRIDDHI*, VOl-13:1, ISSN: 2229-7111 (Print), ISSN: 2454-5767 (Online).
41.Guleria P. & Sood, M. (2015). Predicting Student Placements Using Bayesian Classification. In *2015 Third International Conference on Image Information Processing*. pp. 109-112.
42.Kavya G., Pranitha Y. & Sanjana A. (2021). Smart System for Student Placement Prediction. *International Journal of Advance Research, Ideas and Innovations in Technology (IJARIIT)*, Vol-7:4; pp.452-455.
43.Bindu J. H. & Dushyanth B. (2021). Student Placement Prediction Using Machine Learning. *International Journal of Creative Research Thoughts (IJCRT)*, Vol-9:6; pp. 577-579. ISSN: 2320-2882.

44.Joy L. C. & Raj A. (2019). A Review on Student Placement Chance Prediction. In *2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS)* (pp. 542-545). DOI: 10.1109/ICACCS.2019.8724051.
45.Sangha R., Satras A., Swamy L. & Deshmukh G. (2016). Student's Placement Eligibility Prediction using Fuzzy Approach. *International Journal of Engineering and Techniques*, Vol-2:6; pp.148-152. Nov-Dec 2016.
46.Gera M. & Goel S. (2015). A Model for Predicting the Eligibility for Placement of Student Using Data Mining Technique. In *International Conference on Computing, Communication, and Automation*. pp.114-117.
47.Rawat S. (2019). Predictive Analytics for Placement of Student: A Comparative Study. *International Research Journal of Engineering and Technology (IRJET)*, Vol-6:6; pp.3423-3429.
48.Rao A., Deeksha K. C., Vishal P. R., Vrushak K. & Nandini M. S. (2018). Student Placement Analyzer: A Recommendation System Using Machine Learning. *IJARIIE*, Vol-4:3 ; pp. 2058-2060.
49.Mishra T., Kumar D. & Gupta S. (2017). Students' Performance and Employability Prediction through Data Mining: A Survey. *Indian Journal of Science and Technology*, Vol-10(24). DOI: 10.17485/ijst/2017/v10i24/110791. June 2017.
50.Mishra T., Kumar D. & Gupta S. (2014). Mining Students' Data for Performance Prediction. In *2014 Fourth International Conference on Advanced Computing & Communication Technologies*. DOI: 10.1109/ACCT.2014.105, 255-262.
51.Santhosh J. & K.T Navyamol. (2021). Student Placement Prediction Using Weka. In *Proceedings of the National Conference on Emerging Computer Applications (NCECA)-2021*, Vol-3(1); pp.153-155. DOI: 10.5281/zenodo.5101087.
52.Bharambe Y., More N., Mulchandani M., Shankarmani R. & Shinde S. G. (2017). Assessing Employability of Students using Data Mining Techniques. In *Proceedings of the IEEE Conference* , 2110-2114.
53.Pruthi K. & Bhatia P. (2015). Application of Data Mining in Predicting Placement of Students. In Proceedings of the 2015 International Conference on Green Computing and Internet of Things (ICGCloT) , pp.528-533.
54.Rao A. S., Kumar A. S. V., Jogi P., Bhat C. K., Kumar K. B. & Gouda, P. (2019). Student Placement Prediction Model: A Data Mining Perspective for Outcome-Based Education System. *International Journal of Recent Technology and Engineering (IJRTE)*, Vol-8:3; pp.2497-2507. DOI: 10.35940/ijrte.C4710.098319.
55.Hazra S. & Sanyal S. (2016). Recruitment Prediction Using ID3 Decision Tree. *International Journal of Advance Engineering and Research Development*, Vol-3(10); pp.48-52.
56.Puri N., Khot D., Shinde P., Bhoite K. & Maste, D. (2015). Student Placement Prediction Using ID3 Algorithm. *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, Vol-3(III), ISSN: 2321-9653.
57.Shahane P. (2022). Campus Placements Prediction & Analysis using Machine Learning. In *2022 International Conference on Emerging Smart Computing and Informatics (ESCI)* (pp. 1-5). AISSMS Institute of Information Technology, Pune, India.
58.Kashid,S. S., Badgujar A., Khairnar V., Sagane A. & Ahire N. (2023). Campus Placement Prediction System Using Machine Learning. *International Research Journal of Modernization in Engineering Technology and Science*, 05(04), Impact Factor- 7.868, [5271-5278].
59.Radhika A. V. S., Rachana V. & Sadhvika, S.Student Placement Prediction System. *International Journal of Scientific Research in Science and Technology*, Vol-10:2; pp. 485-488. doi: https://doi.org/10.32628/IJSRST
60.Kumar M., Walia N., Bansal S., Kumar G., & Cengiz K. (2023). Predicting College Students' Placements Based on Academic Performance Using Machine Learning Approaches. *I.J. Modern Education and Computer Science*, 6, pp.1-13. Published online on December 8, 2023 by MECS Press. DOI: 10.5815/ijmecs.2023.06.01.

61. Joshi A., Hutke A., Thete A., Aware D., Rawale S., & Kandalkar N. A. (2024). College placement prediction and analysis using data science. *International Research Journal of Modernization in Engineering Technology and Science*, Vol-6(3); pp.4336-4340.
62. Shetty I. D., Shetty D. & Roundhal S. (2019). Student performance prediction. *International Journal of Computer Applications Technology and Research*, Vol-8:5; pp. 157-160.
63. Ruparel M. & Swaminarayan P. (2024). Student placement prediction using various machine learning techniques. *International Journal of Intelligent Systems and Applications in Engineering*, VOl-12:3 ; pp.2107–2113.
64. Kandekar P., Raut M., Kadam S., Aundhkar A., Divekar A. & Ithule P. (2024). SMART PREP: Smart preparation web application for placements using machine learning. *International Research Journal of Engineering and Technology (IRJET)*, Vol-11(03); pp. 22-29.
65. Ahamed M. A., Chaisanit P. & Mahesh T. R. (2019). Performance of student prediction. *International Journal of Computer Science and Mobile Computing (IJCSMC)*, Vol-8(6); pp. 45-50.
66. Nesamanikandan M., Kannan M. & Pushpanathan R. (2016). Placement analysis using data mining. *International Journal of Advanced Engineering Research and Science (IJAERS)*, 3(6), 194-198. 67. Asif S. & Nafis T. (2019). Students' placement prediction using classification techniques. *International Journal of Computer Sciences and Engineering*, Vol-7(4); pp. 289-293.
68. Patel T., & Tamrakar A. (2017). A data mining techniques for campus placement prediction in higher education. *Indian Journal of Scientific Research*, Vol-14:2, pp.467-471.
69. VidyaShreeram, N., & Muthukumaravel, A. (2021). Student Career Prediction Using Decision Tree and Random Forest Machine Learning Classifiers. Presented at I3CAC 2021, June 07-08, Chennai, India. DOI: 10.4108/eai.7-6-2021.2308621.
70. Khamkar P., Lagad R., Shinde P., & Londhe S. (2023). Student's Placement Prediction System. Vol-9:3, IJARIIE, ISSN(O)-2395-4396, 20466, pp. 2671.
71. Wankhade S. A., Nikam A. A., Borkar S. P. & Mamarde P. S. (2024). A Review on Navigation Tomorrow: A Machine Learning Approach to Campus Placement Prediction. International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Vol-13:3, March 2024, e-ISSN: 2319-8753, p-ISSN: 2347-6710, DOI: 10.15680/IJIRSET.2024.1303055; pp.1635-1637.
72. Kumar T. R., Yasaswini P., Rafi G. & Krishna D. V. (2018). Comparative Analysis on Job Placement of Students Based on Resume Using Data Mining Techniques. International Journal of Engineering & Technology (IJET), Vol-7(2.7); pp.1100-1103.
73. Ashok M. V. & Apoorva A. (2016). Data Mining Approach for Predicting Student and Institution's Placement Percentage. In 2016 International Conference on Computational Systems and Information Systems for Sustainable Solutions (pp.1-5). DOI: 10.1109/CSISSS.2016.7489957.
74. Uskov V. L., Bakken J. P., Shah A. & Byerly A. (2019). Machine Learning Based Predictive Analytics of Student Academic Performance in STEM Education. In 2019 IEEE Global Engineering Education Conference (EDUCON) (pp. 1370-1376). DOI: 10.1109/EDUCON.2019.8725158.
75. Pojon M. (2017). Using Machine Learning to Predict Student Performance (Master's thesis, University of Tampere, Faculty of Natural Sciences).
76. Parvathy G. S. & Smitha R. (2024). A Placement Prediction System for Polytechnic Students. *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, Vol-12(3).
77. Krishna D. R., Prasad B., & Murthy T. S. (2014). Placement Prediction Analysis in University Using Improved Decision Tree Based Algorithm. *International Journal of Computer Trends and Technology (IJCTT)*, VOl-17:4; pp.190-194. DOI: 10.14445/22312803/IJCTT-V17P136.
78. Dadapeer Kusuma, Sindhuja Monika & Shwetha Y. (2022). Student Placement Prediction System Using Classification Techniques. *International Research Journal of Modernization in Engineering, Technology and Science*, Vol-4:7, pp.2781-2785.
79. Parekh S., Parekh A., Nadkarni A. & Mehta R. (2016). Results and Placement Analysis and Prediction using Data Mining and Dashboard. *International Journal of Computer Applications (0975 – 8887)*, Vol-137(13); pp.22-25.

80. Rani P., & Vohra R. (2015). Generating Placement Intelligence in Higher Education Using Data Mining. *International Journal of Computer Science and Information Technologies*, Vol-6(3); pp.2341-2345.
81. Karalingannavar M. R., Kelageri K. S. & Hittalamani V. (2023). Student Placement Prediction Using Machine Learning. *International Research Journal of Modernization in Engineering Technology and Science*, VOl-5:9; pp. 245-248.
82. Hamsa H., Indiradevi S., & Kizhakkethottam J. J. (2016). Student academic performance prediction model using decision tree and fuzzy genetic algorithm. In *Global Colloquium in Recent Advancement and Effectual Researches in Engineering, Science and Technology, RAEREST 2016* (pp. 326-332).
83. Tiwari R., & Sharma A. K. (2015). A Data Mining Model to Improve Placement. *International Journal of Computer Applications*, Vol-120(12); pp.36-38
84. Nichat A. A., & Raut A. B. (2017). Predicting and Analysis of Student Performance Using Decision Tree Technique. *International Journal of Innovative Research in Computer and Communication Engineering*, Vol-5(4); pp.7319-7328. DOI: 10.15680/IJIRCCE.2017.0504144.
85. Marium-E-Jannat, Sayma Sultana Chowdhury & Munira Akther (2016). A Probabilistic Machine Learning Approach for Eligible Candidate Selection. *International Journal of Computer Applications*, Vol-144:10; pp. 1-4.
86. Daud A., Aljohani N. R., Abbasi R. A., Lytras M. D., Abbas F. & Alowibdi J. S. (April 2017). Predicting Student Performance using Advanced Learning Analytics. Conference Paper. DOI: 10.1145/3041021.3054164
87. Kalbande V. N., & Handa C. C. (June 2015). Developing a Model to Predict Employability of Engineering Students in Campus Placement for IT Sector. International Journal of Advance Research in Engineering, Science & Technology (IJAREST), Vol-2(6); pp. 201-206
88. Piad K. C., Dumlao M., Ballera M. A., & Ambat S. C. (2016). Predicting IT Employability Using Data Mining Techniques. In Proceedings of The Third International Conference on Digital Information Processing, Data Mining, and Wireless Communications, Moscow, Russia.
89. Shejwal P. N., Patil N., Bobade A., Kothawade A., & Sangale S. (2019). A Survey on Student Placement Prediction using Supervised Learning Algorithms. International Journal of Research in Engineering, Science and Management, Vol-2:11; pp. 684-685
90. Velaga A., Gayathri V., Chandran S., & Vishnu V. (2024). CAMPUS PLACEMENT PREDICTION – AI ML: Empowering Organisations for better candidature using Artificial Intelligence. IJCRT, Vol-12(3); pp. 244-259
91. Paul K., Karan S., Kuri S., Das S., & Chaudhuri A. K. (2022). Placement Prediction Using Multiple Logistic Regression Method. International Journal of Advanced Research in Computer and Communication Engineering, Vol-11(3); pp.337-344. DOI: 10.17148/IJARCCE.2022.11337
92. Mandal A., Shruthi S. S., & Yogadisha S. (2021). Prediction of placement of candidates using KNN, Logistic Regression and Random Forest model. International Journal of Creative Research Thoughts (IJCRT), Vol-9:5, pp.232-237. © 2021 IJCRT | ISSN: 2320-2882.
93. Byagar S., Patil R., & Pawar J. (2024). Maximizing Campus Placement Through Machine Learning. Journal of Advanced Zoology, Vol-45:S-4; pp.6-12. ISSN: 0253-7214
94. Nutipalli P., Priyanka D., Yuktha L., Prasanth P., Ramsai T., & Jagansai V. (2022). Model Construction Using ML for Prediction of Student Placement. International Journal for Research in Applied Science & Engineering Technology (IJRASET), Vol-10:VI, 2213. ISSN: 2321-9653.
95. Muraina I. O., Agoi M. A. & Omorojar B. O. (2022). Forecasting Students' Job Placement using Data Science Paradigms. International Journal of Education and Learning Systems, 7, pp.27-34. ISSN: 2367-8933.
96. Perez J. G., & Perez E. S. (2021). Predicting Student Program Completion Using Naïve Bayes Classification Algorithm. *I.J. Modern Education and Computer Science*, 2021(3), pp.57-67. DOI: 10.5815/ijmecs.2021.03.05. Published Online June 2021 in MECS
97. Cardona T. A. (2019). Predicting Degree Completion through Data Mining. American Society for

Engineering Education (ASEE). Missouri University of Science and Technology.
98. Suganthi G., & Ashok M. V. (2016). Unique Data Mining Approach to Predict Placement Chance. *International Journal of Engineering Sciences & Research Technology (IJESRT)*, pp.263-269. DOI: 10.5281/zenodo.400931.
99. Rai K. (2022). Students Placement Prediction Using Machine Learning Algorithms. *South Asia Journal of Multidisciplinary Studies (SAJMS)*, Vol-8:5; pp.54-60.
100. Patel N. K. M., Goutham N. M., Inzamam K. A., Kandi S. V. & Sharan V. R. V. (2022). Placement Prediction and Analysis using Machine Learning. *International Journal of Engineering Research & Technology (IJERT)*, ICEI - 2022 Conference Proceedings, pp.224-227.
101. Hariharan VJ , Abdullah Sheik , Rithish R., Prabakar Vishaak , Suguna M. ,Ramakrishnan M. and Selvakumar S., Predicting student's placement prospects using Machine learning Techniques (June 19, 2022). Proceedings of the International Conference on Innovative Computing & Communication(ICICC)2022,SSRN: https://ssrn.com/abstract=4140544 or http://dx.doi.org/10.2139/ssrn.4140544
102. Clemente C. J. & Kwak M. (2022). Utilizing Data Science and Analytics in Predicting Campus Placement. *Issues in Information Systems*, Vol-23:3; pp.53-63. DOI: https://doi.org/10.48009/3_iis_2022_106
103. Kumar R. V., Soumyasree K., Maniradhar P. Saikumar S. & Saikiran K. (2022). Student Placement Prediction Using Machine Learning. *International Journal of Research and Computational Technology*, Vol-14:1; pp. 11-18. ISSN: 0975-5662.
104. Joshi R., Shilwant V., Dandge R., Rajput S. & Thakur M. A. (2024). Placement Prediction and Analysis using Machine Learning. *Journal of Emerging Technologies and Innovative Research (JETIR)*, Vol-11:2; pp.145-150.
105. Lutukurthi S. A., & Sudha Rani T. (2023). Student Placement Prediction Using Machine Learning Models (KNN, SVM, RF, Logistic Regression). In KVS Ramachandra Murthy et al. (Eds.), *Recent Developments in Electronics and Communication Systems* (pp.289-295). DOI: 10.3233/ATDE221271
106. Farhan M. S. (2021). A Real-Time Application to Predict Student Placement Status. *Journal of Emerging Technologies and Innovative Research (JETIR)*, Vol-8:7; pp. c672-c681.

Books:
1. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Publisher: PHI Learning Pvt. Ltd., ISBN: 978-81-203-5078-6
2. Tom Mitchell, "Machine Learning", McGraw Hill Education, 2013
3. C. R. Kothari, Research Methodology Methods and Techniques, New Age International Publishers.

Online Resources:
1. https://epgp.inflibnet.ac.in/.
2. www.dtemaharashtra.gov.in
3. https://www.kaggle.com/
4. www.forms.google.com
5. https://mathcracker.com/critical-correlation-calculator
6. https://share.streamlit.io/
7. https://github.com
8. https://colab.research.google.com/

Campus placement predictive model link :

https://mgmumca.streamlit.app/